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U. S. DEPARTMENT OF AGRICULTURE - FOREST SERVICE

FINANCIAL ASPECTS OF PRUNING PLANTED SLASH PINE

by

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The recent tremendous surge in the planting of southern pines will soon bring a corresponding surge of interest in the profitability of pruning. In anticipation of such interest, this paper presents some cost and return figures for pruning planted slash pine.

Since the idea of pruning is to produce the maximum proportion of clear lumber, the knotty core must be held to a small diameter. This in turn means that the tree should be pruned at an early age, and preferably in two phases. Results from a study[1/] at the George Walton Experimental Forest, Dooly County, Georgia, indicate that the first phase of pruning to a height of 8 feet should be accomplished when the trees are 15 feet tall (about 5 or 6 years of age), and the second phase to a height of 17 feet when the trees are about 33 feet tall (about 5 or 6 years later). By this method the knotty core can be held to a minimum diameter of 5 inches, and after each pruning the tree is left with a crown ratio of about 50 percent, a fact which insures that little or no loss in either diameter or height growth will be incurred.

What is the cost of this two-phase pruning? Records for the pruning of 21,400 trees on the Experimental Forest provide a good sample of cost data. Mr. H. E. Walton, owner of the forest and cooperator with the U. S. Forest Service in forest management research, paid for the work at the rate of 1 cent per tree for the first phase (pruning to 8 feet), and 4 cents per tree for the second phase (8 to 17 feet), making a total of 5 cents per tree. The entire cost for labor, supervision, travel, and marking of trees to be pruned is given in table 1.

The cost of marking the crop trees to be pruned in the second phase may appear too high, when compared with first-phase marking cost. Judging from experience, however, the second marking requires just about as long as the first because there are certain trees that must be eliminated. This results from forking and other conditions that develop after the first pruning, plus the occasional poor tree that was originally marked by error.

[1/] Bennett, Frank A. A practical schedule for pruning planted slash pine. Southeastern Forest Expt. Sta. Research Note 53. 1954.

Table 1.--Two-phase pruning costs per tree for planted slash pine

Pruning level (Feet)	Labor	Marking	Strawboss and tallyman	Mileage	Total
	Cents	Cents	Cents	Cents	Cents
0 - 8	1.00	1.00	0.37	0.06	[1] 2.43
8 - 17	4.00	1.00	1.15	0.25	[2] 6.40
Sum	5.00	2.00	1.52	0.32	8.83

[1] Based on a total of 15,761 trees.
[2] Based on a total of 5,639 trees.

We now come to the question of clear volumes to be expected from the pruning operation. The clear volume of any log is equal, of course, to the total volume minus the knotty volume. Since the total volume of our pruned butt log can be scaled directly, the problem is to determine the volume of the knotty core, which we know to be 5 inches in diameter. Based on the International $\frac{1}{4}$-inch log rule, a 5-inch 16-foot log contains 10 board-feet. Added to this, however, must be a slab volume for the 5-inch core. According to Smith [2] this slab volume can be calculated as 2.568 (diameter of the knotty core plus 0.75). Thus, to determine the clear volume of any pruned log, the following simple formula will suffice:

$$\text{Clear volume} = \text{total volume} - \left[\text{volume knotty core} + 2.568(\text{diameter knotty core} + 0.75)\right]$$

To go further and develop a table of clear volumes for butt logs of various sizes is simple. And by synthesizing a few points, the time involved and a net return can be established. For example, extensive records show that up to 20 years an annual diameter growth of 0.50 inch can be expected of the better trees with rather wide spacing on good sites. It seems reasonable to assume that we can expect 0.35 inch for another 10 years, and 0.30 inch thereafter through judicious management. Since records also show that at 16 years unpruned planted trees have an average form class of 68, it seems reasonable to expect an average form class of 76 at 20 years of age for pruned trees. Only the better trees were selected for pruning, and pruning will tend to increase the form class, since the greatest diameter growth is established as being at the base of the live crown. Also, as the tree ages, the form class will increase. Five percent is accepted by Mr. Walton as a fair rate of interest to place on the pruning investment, and present southern pine prices show an average differential of $30 to $35 per thousand board-feet between No. 1 common and clears. Table 2, based on these various factors, illustrates the clear volume, the cost, and the net return from pruned butt logs of different sizes. To point up the advisability of pruning early in order to hold the diameter of the knotty core as small as possible, data for different size knotty cores are included. The 5-inch knotty core represents an average tree pruned at the appropriate age and according to the recommended schedule. The 6-inch knotty core represents a tree pruned at a later age, and the 7-inch knotty core at a still later age.

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[2] Smith, J. H. G. The Economics of Pruning, Forestry Chronicle. 30: 2. June 1954.

In arriving at the total cost and net return, adjustments were made, according to Shaw and Staebler,[3] for those pruned trees that are lost for one reason or another along the way. The figures are based on the premise that 150 trees per acre should be pruned in the first phase. It is then estimated that 10 percent of these trees will be eliminated or lost for the second phase. Of the remaining 135 trees that are pruned in the second phase it is estimated that 7.5 percent will be lost through mortality and other causes before the remaining ones are removed in intermediate and harvest cuts.

Considering these factors, pruning costs were adjusted as follows:

First phase:		
Cost per tree	2.43 cents	
10 percent lost for 2nd phase, and thus final cost per tree is $\frac{2.43}{.90}$ =	2.70 cents	
2.70 cents compounded at 5 percent for 5 years, or until the second phase is accomplished, gives a complete first-phase cost per tree of		3.45 cents
Second phase:		
Cost per tree	6.40 cents	
Adjusting for loss of 10 trees, or estimated 7.5 percent loss, final cost per tree is $\frac{6.40}{.925}$ =		6.92 cents
	Total	10.37 cents

The figure of 10.37 is rounded to 10 cents in the table calculations and compounded at 5 percent for the appropriate number of years.

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[3] Shaw, Elmer W. and Staebler, George R. An Analysis of Investments in Pruning. Journal of Forestry. 50: 11. 1952.

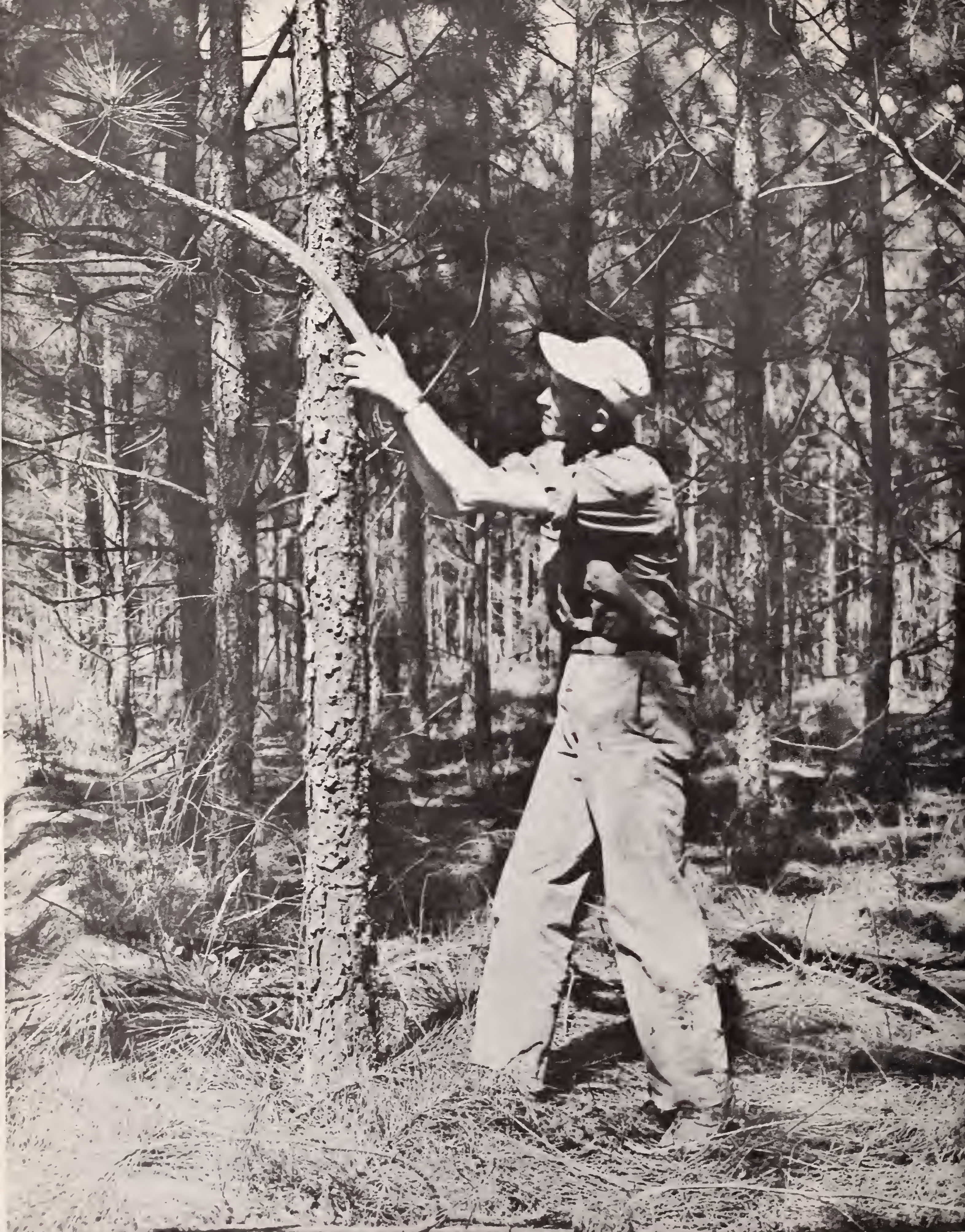

Figure 1.--First-phase pruning to 8-foot level at about 6 years of age.

Table 2.--Clear volume and net return comparisons for pruned butt logs of various sizes and knotty cores of different sizes

5-INCH KNOTTY CORE

Scaling d.i.b. (Inches)	D.b.h.	Age	Form class	Clear shell thickness	Volume			Pruning cost at harvest	Net return per log [1]
					Total	Knotty	Clear		
	Inches	Years	Percent	Inches	- - -	Bd. ft.	- - -	Cents	Dollars
9	11.8	25	76	2.0	50	27	23	19.8	0.49
10	12.8	28	76	2.5	65	27	38	22.9	0.91
11	14.0	32	78	3.0	80	27	53	27.9	1.31
12	15.2	36	78	3.5	95	27	68	33.9	1.70
13	16.4	40	78	4.0	115	27	88	41.1	2.23
14	17.6	44	80	4.5	135	27	108	50.0	2.74
15	18.8	48	80	5.0	160	27	133	60.8	3.38
16	20.0	52	80	5.5	180	27	153	73.9	3.85
6-INCH KNOTTY CORE									
10	12.8	28	76	2.0	65	37	28	22.9	0.61
11	14.0	32	78	2.5	80	37	43	27.9	1.01
12	15.2	36	78	3.0	95	37	58	33.9	1.40
13	16.4	40	78	3.5	115	37	78	41.1	1.93
14	17.6	44	80	4.0	135	37	98	50.0	2.44
15	18.8	48	80	4.5	160	37	123	60.8	3.08
16	20.0	52	80	5.0	180	37	143	73.9	3.55
7-INCH KNOTTY CORE									
11	14.0	32	78	2.0	80	50	30	27.9	0.62
12	15.2	36	78	2.5	95	50	45	33.9	1.01
13	16.4	40	78	3.0	115	50	65	41.1	1.54
14	17.6	44	80	3.5	135	50	86	50.0	2.08
15	18.8	48	80	4.0	160	50	110	60.8	2.69
16	20.0	52	80	4.5	180	50	130	73.9	3.16

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[1] Based on a premium of $30 per M bd. ft. for clears.

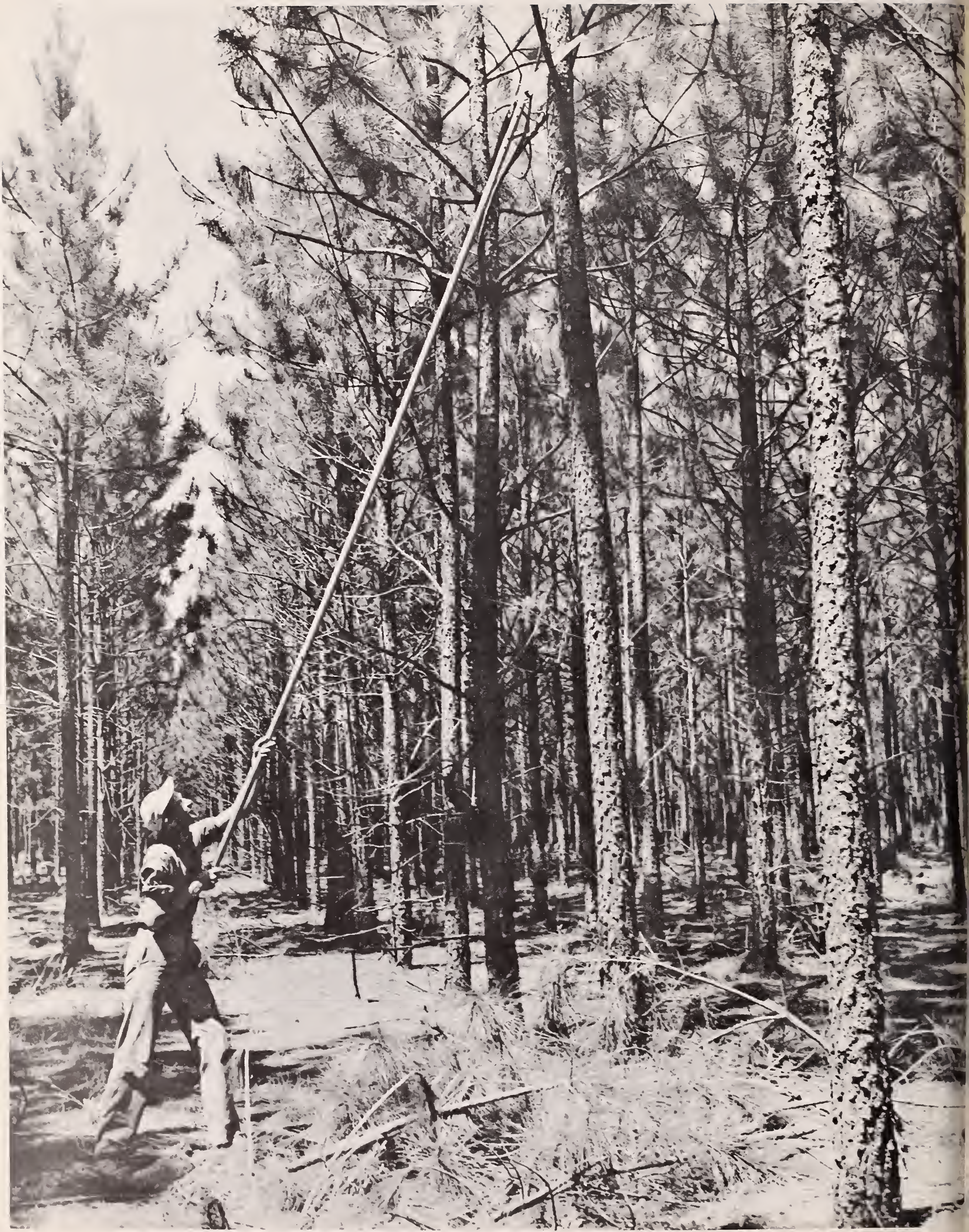

Figure 2.--Second-phase pruning at about 11 years of age.

The advantage of holding the diameter of the knotty core as low as possible is clearly shown in table 2. Not only is the volume of clear material increased, but clear material can be cut at younger ages and smaller sizes. This means that clear volume need not be restricted to the final crop trees, but can be produced in trees removed in intermediate cuts. Inspection of table 2 shows, for instance, that with a knotty core of 5 inches at 32 years of age the net return from pruning one butt log is $1.31, while with a 6-inch knotty core it is only $1.01, and with a 7-inch core only $0.62.

The interest rate of 5 percent may not be appropriate for any and all operations. The rate may vary between ownerships or between regions. For these reasons, table 3 presents earnings from pruning at various interest charges. It should be pointed out here that the net return from pruning does not increase indefinitely with age, as might be inferred from the tables. Eventually, say at 40 to 50 years, unpruned stands begin to produce some clear volume. Consequently, the proportion of the growth in clear volume attributable to pruning begins to diminish, while the compounded cost of pruning continues to rise.

Table 2 shows no saleable clear volume until 25 years of age, with all limbs having been removed at 11 years of age to a 5-inch knotty core. Inspection of 10-year-old plantations spaced 6 by 8 feet shows that no trees have shed the first whorl of branches, although the branches died some years ago. This indicates that the possibility of producing clear volume through natural pruning at early ages is remote. In order to induce natural pruning at a reasonable age, the density must be allowed to reach a point that shortens crown ratios to an extreme not commensurate with good management. Not only would diameter growth be reduced materially, but slash pine appears to reach a point beyond which it loses the ability to respond promptly to release. This has been observed on the experimental forest more than once.

In expanding the cost and return figures in table 2 to an acre basis, table 4 presents a projected 5-year cutting cycle for a plantation and outlines the returns from pruning the butt log on 125 crop trees.

On the basis of a 50-year rotation, the premium received for the clear lumber in the butt log, beyond the cost of pruning, averages $266.52 per acre. As granted earlier, a portion of the clear volume added in the last 10-15 years is probably not the result of pruning. We can concede, however, that no clear volume added after 30 years of age is attributable to pruning, and still show a net gain in lumber value of $94.27--assuming, that is, that all clear volume added before 30 years is the result of pruning.

Table 3.--Net return comparisons for pruned slash pine at various interest rates

5-INCH KNOTTY CORE

Scaling d.i.b. (Inches)	D.b.h.	Age	Clear volume	Net return at--				
				3%	4%	5%	6%	7%
	Inches	Years	Bd. ft.	Dollars				
9	11.8	25	23	0.54	0.52	0.49	0.46	0.43
10	12.8	28	38	0.97	0.95	0.91	0.87	0.82
11	14.0	32	53	1.40	1.36	1.31	1.25	1.18
12	15.2	36	68	1.82	1.77	1.70	1.61	1.50
13	16.4	40	88	2.40	2.33	2.23	2.10	1.93
14	17.6	44	108	2.98	2.88	2.74	2.56	2.31
15	18.8	48	133	3.70	3.56	3.38	3.13	2.77
16	20.0	52	153	4.26	4.09	3.85	3.50	2.99
6-INCH KNOTTY CORE								
10	12.8	28	28	0.67	0.65	0.61	0.57	0.52
11	14.0	32	43	1.10	1.06	1.01	0.95	0.88
12	15.2	36	58	1.53	1.47	1.40	1.31	1.20
13	16.4	40	78	2.10	2.03	1.93	1.80	1.63
14	17.6	44	98	2.68	2.58	2.44	2.26	2.01
15	18.8	48	123	3.37	3.26	3.08	2.83	2.47
16	20.0	52	143	3.95	3.79	3.55	3.20	2.69
7-INCH KNOTTY CORE								
11	14.0	32	30	0.71	0.67	0.62	0.56	0.49
12	15.2	36	45	1.14	1.08	1.01	0.92	0.81
13	16.4	40	65	1.71	1.64	1.54	1.41	1.24
14	17.6	44	86	2.28	2.22	2.08	1.90	1.65
15	18.8	48	110	2.98	2.87	2.69	2.44	2.08
16	20.0	52	130	3.56	3.40	3.16	2.81	2.30

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Table 4.--A projected 5-year cutting cycle for a slash pine plantation, illustrating the return per acre from pruned trees

Age (Years)	D.b.h.	Trees	Basal area		Trees cut	Clear volume cut[2]	Premium from pruning	Cost of pruning	Net return from pruning[1]
			Before cutting	After cutting					
	Inches	Number	Square feet		Number	Board feet	Dollars		
25	11.8	125	94.92	83.60	15	345	10.35	2.97	7.38
30	13.5	110	109.34	84.49	25	925	27.75	6.32	21.43
35	15.0	85	104.31	85.90	15	1,050	31.50	4.83	26.67
40	16.5	70	103.94	86.12	12	1,068	32.04	4.93	27.11
45	17.7	58	99.10	82.02	10	1,090	32.70	5.25	27.45
50	19.2	48	96.51	--	48	6,288	188.64	32.16	156.48
Totals	--	--	--	--	--	10,766	$322.98	$56.46	$266.52

[1] On the basis of a 5-inch knotty core and a premium of $30 per M bd. ft. for clears.

[2] From butt logs only.

It has been stated that the owner cannot realize a benefit from pruning because buyers of either stumpage or logs will not recognize the presence of clear material and consequently will bid no more than for the average unpruned stand or log. Yet all buyers admit they bid considerably more for a stand with a good percentage of clears than for a stand with few or no clears. This being true, there appears little reason to doubt that an owner can realize a good profit from pruning planted slash pine if he markets his timber on a competitive basis and gives assurance to the bidders of a certain minimum volume of clear material.

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